Table J-46. Nevada routing sensitivity cases analyzed for a legal-weight truck.

Case	Description
Case 1	To Yucca Mountain via Barstow, California, using I-15 to Nevada 160 to Nevada 160 (Nevada D and F)
Case 2	To Yucca Mountain via Barstow using I-15 to California route 127 to Nevada 373 to US 95 (Nevada C)
Case 3	To Yucca Mountain via Needles using U.S. 95 to Nevada 164 to I-15 to California 127 to Nevada 373 and U.S. 95 (Nevada E)
Case 4	To Yucca Mountain via Needles using U.S. 95 to Nevada 164 to I-15 to Nevada 160 (variation of Nevada E)
Case 5	To Yucca Mountain via Wendover using U.S. 93 Alternate to U.S. 93 to U.S. 6 to U.S. 95 (Nevada B)
Case 6	To Yucca Mountain via Wendover using U.S. 93 Alternate to U.S. 93 to Nevada 318 to U.S. 93 to I-15 to the Las Vegas Beltway to U.S. 95 (Nevada A)
Case 7	To Yucca Mountain via Las Vegas using I-15 (for shipments entering Nevada at both the Arizona and California borders) to U.S. 95 (Spaghetti Bowl interchange)

J.3.2 ANALYSIS OF INCIDENT-FREE TRANSPORTATION IN NEVADA

The analysis of incident-free impacts to populations in Nevada addressed transportation through urban, suburban, and rural population zones. The population densities used in the analysis were determined using Geographic Information System methods, population data from the 1990 Census, and projected populations along the Las Vegas Beltway (DIRS 155112-Berger 2000, pp. 59 to 64). The analysis extrapolated impacts to account for population growth to 2035. The populations within the 800-meter (0.5-mile) regions of influence used to evaluate the impacts of incident-free transportation for legal-weight truck, heavy-haul truck, and rail shipments are listed in Table J-35. The table lists the estimated 2035 populations.

Average highway vehicle densities for Nevada were calculated from vehicle traffic counts on Interstate and primary U.S. highways in Nevada counties that would be used for transporting spent nuclear fuel and high-level radioactive waste (DIRS 156930-NDOT 2001, all). The analysis used the average speed of trains on a branch rail line in Nevada from (DIRS 101214-CRWMS M&O 1996, Volume 1, Section 4, Branch Line Operations Plan). Heavy-haul trucks in Nevada would be escorted. The analysis assumed that heavy-haul truck shipments would originate in Caliente, Nevada, and would stop overnight en route to the repository. Input parameters for analysis of incident-free transportation in Nevada that differ from, or are additional to, values used to analyze impacts outside the State, are listed in Table J-49. Parameters not listed in this table are the same as those listed in Tables J-15 and J-17. Unit risk factors for incident-free transportation in Nevada are listed in Table J-50.

Results for incident-free transportation of spent nuclear fuel and high-level radioactive waste for Inventory Modules 1 and 2 are presented in Section J.3.4.

J.3.3 ANALYSIS OF TRANSPORTATION ACCIDENT SCENARIOS IN NEVADA

Section J.1.4 discusses the methodology for estimating the risks of accidents that could occur during rail and truck transportation of spent nuclear fuel and high-level radioactive waste. Section J.3.5 describes the results of the accident risk analysis for Inventory Modules 1 and 2.

J.3.3.1 Intermodal Transfer Station Accident Methodology

Shipping casks would arrive at an intermodal transfer station in Nevada by rail, and a gantry crane would transfer them from the railcars to heavy-haul trucks for transportation to the repository. The casks, which would not be opened or altered in any way at the intermodal transfer station, would be certified by the Nuclear Regulatory Commission and would be designed for accident conditions specified in 10 CFR Part 71. Impact limiters, which would protect casks against collisions during transportation, would remain in place during transfer operations at the intermodal transfer station.

Table J-47. Comparison of national impacts from the sensitivity analyses.

Impact	Base case	Case 1 Barstow via Nevada 160	Case 2 Barstow via California 127	Case 3 Needles via Nevada 160	Case 4 Needles via U.S. 95	Case 5 Wendover via U.S. 95	Case 6 Wendover via Las Vegas Beltway	Case 7 I-15 and U.S. 95 (Spaghetti Bowl)
Public incident-free dose (person-rem)	5,000	5,200	5,100	4,900	5,000	4,600	4,800	5,100
Occupational incident-free dose (person-rem)	14,000	15,000	15,000	14,000	14,000	15,000	15,000	14,000
Nonradioactive pollution health effects	0.93	0.93	0.93	0.89	0.88	0.79	0.81	1.1
Public incident-free risk of latent cancer fatality	2.5	2.6	2.6	2.4	2.5	2.3	2.4	2.6
Occupational incident-free risk of latent cancer fatality	5.6	6	5.8	5.6	5.7	5.9	5.9	5.6
Radiological accident risk (person-rem)	0.46	0.36	0.35	0.35	0.35	0.39	0.4	0.52
Radiological accident risk of latent cancer fatality	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003
Traffic fatalities	4.5	4.5	4.2	4.3	4.2	4.9	5	4.5

Table J-48. Comparison of Nevada impacts from the sensitivity analyses.

Impact	Base case	Case 1 Barstow via Nevada 160	Case 2 Barstow via California 127	Case 3 Needles via Nevada 160	Case 4 Needles via U.S. 95	Case 5 Wendover via U.S. 95	Case 6 Wendover via Las Vegas Beltway	Case 7 I-15 and U.S. 95 (Spaghetti Bowl)
Public incident-free dose (person-rem)	340	180	35	170	83	360	490	480
Occupational incident-free dose (person-rem)	1,900	1,800	1,200	1,800	1,400	3,400	3,500	1,900
Nonradioactive pollution health effects	0.09	0.01	<0.005	0.01	<0.005	0.03	0.04	0.21
Public incident-free risk of latent cancer fatality	0.17	0.09	0.02	0.08	0.04	0.18	0.24	0.24
Occupational incident-free risk of latent cancer fatality	0.75	0.72	0.47	0.7	0.54	1.4	1.4	0.74
Radiological accident risk (person-rem)	0.052	0.005	0.002	0.004	0.002	0.015	0.027	0.11
Radiological accident risk of latent cancer fatality	0.000026	0.000003	0.000001	0.000002	0.000001	0.000008	0.000013	0.000055
Traffic fatalities	0.5	0.4	0.1	0.4	0.2	1.3	1.3	0.5

Table J-49. Input parameters and parameter values used for incident-free Nevada truck and rail transportation different from national parameters.

Parameter	Legal-weight truck	Rail	Heavy-haul truck
Speed (kilometers per hour)[a]			
Rural		50	
One-way traffic count (vehicles per hour)			
Rural	(b)		
Suburban	(b)		
Urban	(b)		
Truck crew dose at walkaround inspections			
Distance of crew from cargo (meters)[c]			30
Truck escort dose at walkaround inspections			
Distance of one inspector (meters)			1
Distance of 3 other escorts (meters)			60
Guards at overnight stop[d]			
Distance of 4 guards from cargo (meters)			60
Time of overnight stop (hours)			12

a. To convert kilometers to miles, multiply by 0.62137.
b. County-specific average traffic counts (DIRS 156930-NDOT 2001, all)
c. To convert meters to feet, multiply by 3.2808.
d. Crew and escorts are far enough away from the cargo and shielded sufficiently that they receive no dose from the cargo during the overnight stop. Number of guards and length of overnight stop are assumptions for analysis purposes.

Table J-50. Per-shipment unit risk factors for incident-free transportation of spent nuclear fuel and high-level radioactive waste in Nevada.

Factor	Heavy-haul truck	Rail	Legal-weight truck
Public			
Off-link [rem per (persons per square kilometers) per kilometer]			
Rural	6.24×10^{-8}	5.01×10^{-8}	2.89×10^{-8}
Suburban	6.24×10^{-8}	6.24×10^{-8}	3.18×10^{-8}
Urban	6.24×10^{-8}	1.04×10^{-7}	3.18×10^{-8}
On-link (person-rem per kilometer)[a]			
Rural	1.46×10^{-4}	2.00×10^{-7}	1.38×10^{-5}
Suburban	1.12×10^{-4}	1.55×10^{-6}	3.89×10^{-5}
Urban	5.40×10^{-4}	4.29×10^{-6}	1.87×10^{-4}
Residents near rest/refueling stops (rem per (persons per square kilometer) per kilometer)			
Rural	3.96×10^{-9}	1.24×10^{-7}	5.50×10^{-9}
Suburban	3.96×10^{-9}	1.24×10^{-7}	5.50×10^{-9}
Urban	3.96×10^{-9}	1.24×10^{-7}	5.50×10^{-9}
Residents near classification stops [rem per (persons per square kilometer)]			
Suburban	1.59×10^{-5}		
Public near rest/refueling stops (person-rem per kilometer)			7.86×10^{-6}
Workers			
Classification stop (person-rem)		8.07×10^{-3}	
In-transit stop (person-rem per kilometer)		1.45×10^{-5}	
In moving vehicle (person-rem per kilometer)			
Rural	5.54×10^{-6}		4.52×10^{-5}
Suburban	5.54×10^{-6}		4.76×10^{-5}
Urban	5.54×10^{-6}		4.76×10^{-5}
Crew, walkaround inspection (person-rem per kilometer)	6.27×10^{-7}		1.93×10^{-5}
Escort, walkaround inspection (person-rem per kilometer)	1.50×10^{-5}		
Guards at overnight stops (person-rem)	2.62×10^{-3}		

a. Listed values for on-link unit risk factors are based on Clark County traffic counts. The analysis used country-specific counts for each country through which shipments would pass.

DOE performed an accident screening process to identify credible accidents that could occur at an intermodal transfer station with the potential for compromising the integrity of the casks and releasing radioactive material. The external events listed in Table J-51 were considered, along with an evaluation of their potential applicability.

As indicated from Table J-51, the only accident-initiating event identified from among the feasible external events was the aircraft crash. Such events would be credible only for casks being handled or on transport vehicles at an intermodal transfer station in the Las Vegas area (Apex/Dry Lake or Sloan/Jean).

For a station in the Las Vegas area, an aircraft crash would be from either commercial aircraft operations at McCarran airport or military operations from Nellis Air Force Base.

Among the internal events, the only potential accident identified was a drop of the cask during transfer operations. This accident would bound the other events considered, including drops from the railcar or truck (less fall height would be involved than during the transfer operations). Collisions, derailments, and other accidents involving the transport vehicles at the intermodal transfer station would not damage the casks due to the requirement that they be able to withstand high-speed impacts and the low velocities of the transport vehicles at the intermodal transfer station.

Accident Analysis

1. *Cask Drop Accident.* The only internal event retained after the screening process was a failure of the gantry crane (due to mechanical failure or human error) during the transfer of a shipping cask from a railcar to a heavy-haul truck. The maximum height between the shipping cask and the ground during the transfer operation would be less than 6 meters (19 feet) (DIRS 104849-CRWMS M&O 1997, all). The casks would be designed to withstand a 9-meter (30-foot) drop. Therefore, the cask would be unlikely to fail during the event, especially because the impact energy from the 6-meter drop would be only 65 percent of the minimum design requirement.

2. *Aircraft Crash Accident.* This section, including Tables J-52 and J-53, has been moved to Volume IV of this EIS.

J.3.4 IMPACTS IN NEVADA FROM INCIDENT-FREE TRANSPORTATION FOR INVENTORY MODULES 1 AND 2

This section presents the analysis of impacts to occupational and public health and safety in Nevada from incident-free transportation of spent nuclear fuel and high-level radioactive waste in Inventory Modules 1 and 2. The analysis assumed that the routes, population densities, and shipment characteristics (for example, radiation from shipping casks) for shipments under the Proposed Action and Inventory Modules 1 and 2 would be the same. The only difference was the projected number of shipments that would travel to the repository.

The following sections provide detailed information on the range of potential impacts to occupational and public safety and health from incident-free transportation of Modules 1 and 2 that result from legal-weight trucks and the 10 alternative transportation routes considered in Nevada. National impacts of incident-free transportation of Modules 1 and 2 incorporating Nevada impacts are discussed together with other cumulative impacts in Chapter 8.

J.3.4.1 Mostly Legal-Weight Truck Scenario

Tables J-54 and J-55 list estimated incident-free impacts in Nevada for the mostly legal-weight truck scenario for shipments of materials included in Inventory Modules 1 and 2.